GATE 2026 IN Question Paper with Solutions

Time Allowed :3 Hour	**Maximum Marks :**100	**Total Questions :**65

General Instructions

Please read the following instructions carefully:

1. This question paper is divided into three sections:
   - **General Aptitude (GA):** 10 questions (5 questions × 1 mark + 5 questions × 2 marks) for a total of 15 marks.
   - **Environmental Science and Engineering + Engineering Mathematics:**
     - **Part A (Mandatory):** 36 questions (1 questions × 1 mark + 19 questions × 2 marks) for a total of 55 marks.
     - **Part B (Section 1):** Candidates can choose either Part B1 (Surveying and Mapping) or Part B2 (Section 2). Each part contains 16 questions (8 questions × 1 mark + 11 questions × 2 marks) for a total of 30 marks.
2. The total number of questions is **65**, carrying a maximum of **100 marks**.
3. The duration of the exam is **3 hours**.
4. Marking scheme:
   - For 1-mark MCQs, $\frac{1}{3}$ mark will be deducted for every incorrect response.
   - For 2-mark MCQs, $\frac{2}{3}$ mark will be deducted for every incorrect response.
   - No negative marking for numerical answer type (NAT) questions.
   - No marks will be awarded for unanswered questions.
5. Ensure you attempt questions only from the optional section (Part B1 or Part B2) you have selected.
6. Follow the instructions provided during the exam for submitting your answers.

1. Which of the following transducers is most suitable for measuring very small displacements?

(A) LVDT
(B) Strain gauge
(C) Piezoelectric transducer
(D) Thermistor

Correct Answer: (A) LVDT

Solution:

Step 1: Understanding the requirement of the question.
The question asks for a transducer that is most suitable for measuring **very small linear displacements**. Such a transducer should have high sensitivity, good accuracy, and excellent resolution for minute movements.

Step 2: Analyzing the options.
(A) LVDT: A Linear Variable Differential Transformer (LVDT) is specifically designed to measure linear displacement. It offers very high sensitivity, frictionless operation, and can detect extremely small changes in position with high accuracy.
(B) Strain gauge: A strain gauge measures strain (deformation) in materials and is not directly used for precise displacement measurement.
(C) Piezoelectric transducer: Piezoelectric transducers are mainly used for dynamic measurements such as vibration and pressure, not for static or very small displacements.
(D) Thermistor: A thermistor measures temperature changes and is not related to displacement measurement.

Step 3: Conclusion.
Since LVDT is specifically designed for accurate measurement of very small linear displacements, it is the most suitable choice.

> Quick Tip
>
> LVDTs are preferred for precision displacement measurement due to their high sensitivity, accuracy, and frictionless operation.

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2. For a stable linear time-invariant system, the location of all poles must be:

(A) On the imaginary axis
(B) In the right half of s-plane
(C) In the left half of s-plane
(D) At the origin

Correct Answer: (C) In the left half of s-plane

Solution:

Step 1: Understanding system stability.
For a linear time-invariant (LTI) control system to be stable, its natural response must decay

to zero with time. This behavior depends on the location of the system poles in the s-plane.

Step 2: Relation between pole location and stability.
If the real part of all poles is negative, the exponential terms in the system response decay with time, ensuring stability. Poles on or to the right of the imaginary axis result in sustained or growing oscillations, leading to instability or marginal stability.

Step 3: Analyzing the options.
(A) On the imaginary axis: This leads to sustained oscillations and represents marginal stability, not stable behavior.
(B) In the right half of s-plane: Poles here cause exponential growth, making the system unstable.
(C) In the left half of s-plane: Correct — poles with negative real parts ensure exponential decay and stable system response.
(D) At the origin: This indicates marginal stability and does not guarantee stability.

Step 4: Conclusion.
A stable LTI system must have all its poles strictly located in the left half of the s-plane.

> Quick Tip
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> Remember: **Left half-plane = Stable**, **Imaginary axis = Marginally stable**, **Right half-plane = Unstable**.

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3. An ideal operational amplifier has:

(A) Infinite input impedance and zero output impedance
(B) Zero input impedance and infinite output impedance
(C) Infinite gain and infinite output impedance
(D) Finite gain and finite bandwidth

Correct Answer: (A) Infinite input impedance and zero output impedance

Solution:

Step 1: Understanding the concept of an ideal operational amplifier.
An ideal operational amplifier (op-amp) is a theoretical device used to simplify circuit analysis. It is assumed to have perfect characteristics that are not fully achievable in practical op-amps but are useful for understanding circuit behavior.

Step 2: Key characteristics of an ideal op-amp.
An ideal op-amp draws no input current, which means its input impedance must be infinite. This ensures that the op-amp does not load the input signal source. Additionally, it should be able to supply any required output current without any voltage drop, which implies zero output impedance.

Step 3: Analyzing the options.
(A) Infinite input impedance and zero output impedance: Correct — These are fundamental assumptions of an ideal op-amp and ensure maximum signal transfer and perfect output behavior.
(B) Zero input impedance and infinite output impedance: This is opposite to ideal behavior and would severely load the input signal.
(C) Infinite gain and infinite output impedance: Although infinite gain is an ideal assumption, infinite output impedance is incorrect for an ideal op-amp.
(D) Finite gain and finite bandwidth: These are characteristics of practical op-amps, not ideal ones.

Step 4: Conclusion.
An ideal operational amplifier is characterized by infinite input impedance and zero output impedance, making option (A) the correct answer.

> Quick Tip
>
> Always remember: Ideal op-amp assumptions include infinite gain, infinite input impedance, zero output impedance, and infinite bandwidth.

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4. How many flip-flops are required to design a MOD-10 counter?

(A) 3
(B) 4
(C) 5
(D) 10

Correct Answer: (B) 4

Solution:

Step 1: Understanding a MOD counter.
A MOD-N counter is a digital counter that goes through N distinct states before repeating the counting sequence. A MOD-10 counter must count from 0 to 9, which means it requires 10

unique states.

Step 2: Relation between number of states and flip-flops.
The number of states that can be represented using n flip-flops is given by:

$$2^n$$

We must choose the smallest value of n such that $2^n \geq 10$.

Step 3: Calculating the required number of flip-flops.

$$2^3 = 8 \quad \text{(not sufficient)} 2^4 = 16 \quad \text{(sufficient)}$$

Thus, a minimum of 4 flip-flops is required to represent at least 10 states.

Step 4: Conclusion.
Since 4 flip-flops can represent up to 16 states, they are sufficient to design a MOD-10 counter.

Quick Tip

To design a MOD-N counter, always choose the smallest n such that $2^n \geq N$.

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5. Which type of error is caused due to faulty calibration of instruments?

(A) Gross error
(B) Random error
(C) Systematic error
(D) Environmental error

Correct Answer: (C) Systematic error

Solution:

Step 1: Understanding measurement errors.
Measurement errors occur when the observed value differs from the true value. These errors can arise due to human mistakes, instrument faults, or external conditions.

Step 2: Understanding systematic errors.
Systematic errors are consistent and repeatable errors that occur due to faults in the measuring instrument, improper calibration, or incorrect zero setting. Faulty calibration causes the instrument to give biased readings in the same direction every time.

Step 3: Analyzing the options.
(A) Gross error: These are caused by human mistakes such as incorrect reading or recording.
(B) Random error: These occur due to unpredictable variations and do not follow a fixed pattern.
(C) Systematic error: Correct — faulty calibration causes a consistent deviation in measurements, which is the definition of systematic error.
(D) Environmental error: These errors arise due to changes in temperature, humidity, or pressure.

Step 4: Conclusion.
Since faulty calibration produces consistent and repeatable errors, it results in systematic error.

> **Quick Tip**
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> Errors due to instrument defects or calibration issues always fall under systematic errors.

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6. The Laplace transform of a unit step function $u(t)$ is:

(A) $\frac{1}{s}$
(B) $\frac{1}{s^2}$
(C) s
(D) e^{-s}

Correct Answer: (A) $\frac{1}{s}$

Solution:

Step 1: Understanding the unit step function.
The unit step function $u(t)$ is defined as:

$$u(t) = \begin{cases} 0, & t < 0 \\ 1, & t \geq 0 \end{cases}$$

It represents a signal that switches ON at $t = 0$ and remains constant thereafter.

Step 2: Definition of Laplace transform.
The Laplace transform of a function $f(t)$ is given by:

$$\mathcal{L}\{f(t)\} = \int_0^\infty f(t)\, e^{-st}\, dt$$

Step 3: Applying Laplace transform to $u(t)$.
Since $u(t) = 1$ for $t \geq 0$, we substitute $f(t) = 1$:

$$\mathcal{L}\{u(t)\} = \int_0^\infty e^{-st}\,dt$$

Evaluating the integral:

$$\int_0^\infty e^{-st}\,dt = \left[\frac{-1}{s}e^{-st}\right]_0^\infty = \frac{1}{s}$$

Step 4: Conclusion.
The Laplace transform of the unit step function is $\frac{1}{s}$.

Quick Tip

Always remember the basic Laplace pairs: $u(t) \to \frac{1}{s}$ and $t \to \frac{1}{s^2}$.

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7. In amplitude modulation, the modulation index should be:

(A) Less than 0.5
(B) Equal to 1
(C) Greater than 1
(D) Between 0 and 1

Correct Answer: (D) Between 0 and 1

Solution:

Step 1: Understanding modulation index in AM.
In amplitude modulation (AM), the modulation index m is defined as the ratio of the amplitude of the modulating signal to the amplitude of the carrier signal. It indicates the extent of modulation applied to the carrier.

Step 2: Acceptable range of modulation index.
For distortionless AM transmission, the modulation index must satisfy:

$$0 < m \leq 1$$

If the modulation index exceeds 1, the signal becomes over-modulated, leading to distortion in the received signal.

Step 3: Analyzing the options.
(A) Less than 0.5: This is not necessary; modulation can be effective even when m is greater than 0.5.
(B) Equal to 1: This represents 100% modulation, which is acceptable but not the only valid case.
(C) Greater than 1: This causes over-modulation and distortion, so it is incorrect.
(D) Between 0 and 1: Correct — this range ensures proper modulation without distortion.

Step 4: Conclusion.
To avoid distortion and ensure faithful signal transmission, the modulation index in AM must lie between 0 and 1.

Quick Tip

Over-modulation ($m > 1$) causes envelope distortion in AM signals — always keep $m \leq 1$.
